# TORSION SPRING TENSIONING APPARATUS

## FIELD OF THE INVENTION

The present invention relates to apparatus for tensioning shaft-mounted helical springs, and in particular for tensioning shaft-mounted torsion springs of overhead doors.

## BACKGROUND OF THE INVENTION

Sectional overhead doors for residential and commercial garages typically have a number of hinged horizontal sections with rollers at each end that run inside tracks extending vertically on each side of the door opening. The tracks continue either vertically or, perhaps most commonly, horizontally inward above the door opening to accommodate the door when in its open position. These doors commonly incorporate a counterweighting system to reduce the effective door weight that must be lifted by a manual or motorized door-opening mechanism.

The components of a typical counterweighting system include an elongate round shaft with a pulley at each end, and at least one helical torsion spring mounted generally concentrically on the shaft. The shaft is rotatably mounted to the building structure above and parallel to the door opening. Each pulley has a door-lifting cable attached to the door at a selected point, typically near the bottom of the door. One end of the spring is non-rotatably fixed to the building structure, and the other end is fixed to a spring cone which in turn is lockably mounted onto the shaft (typically by means of set screws). The spring may be tensioned by rotating the spring cone around the shaft and then locking the spring cone on the shaft. The tensioned spring exerts a rotational force on the shaft, inducing tension forces in the cables, which in turn exert upward forces on the door. These upward forces effectively counteract and reduce the weight that needs to be lifted when operating the door.

There are many known types of spring cones, most of which incorporate a number of radial sockets (typically four) into which steel winding rods can be inserted for purposes of winding the spring cone around the shaft to tension the spring. With the spring cone loose on the shaft, a first rod is inserted into one socket and manual force is applied to the rod to rotate the spring cone and one end of the spring a partial turn, thus increasing spring tension. With the first rod being firmly held (to restrain spring tension), a second rod is inserted into another socket and used to turn the cone further. With the second rod being firmly held, the first rod may be withdrawn and moved to a new socket. This alternating process is continued until a desired spring tension has been achieved, whereupon the spring cone is tightened onto the shaft and the rods are removed from the sockets.

This well-known procedure is effective but potentially dangerous. If the rods are accidentally let go of while the spring cone is loose on the shaft, the tensioned spring will quickly unwind, causing the spring cone to spin on the shaft. If one or both rods are still engaged in spring cone sockets, they will spin rapidly with the spring cone and thus may injure a person standing too close. In fact, the rods may even fly out of the spring cone and thus become dangerous projectiles that can seriously injure or even kill a bystander. The danger inherent in such situations is greater for larger and heavier doors, which typically have heavier springs that store greater potential energy when tensioned.

These risks are particularly great when spring tensioning is being attempted by a single worker. Muscle fatigue and momentary inattention or distraction are only two factors that could cause the worker to lose hold of the winding rods. In view of these concerns, it is less dangerous if the spring tensioning procedure is performed by two workers, each operating only one winding rod. Then if one worker becomes unexpectedly tired or inattentive and loses control of one rod, the other worker will in most cases be holding the other rod safely, and preventing the spring from unwinding. An obvious disadvantage of this safer alternative procedure, however, is that the need for two workers results in higher cost for the spring tensioning operation.

For the foregoing reasons, it is desirable to have spring tensioning methods and means that do not use loose winding rods that can cause injury in case of inadvertent and uncontrolled unwinding of a tensioned spring, and, further, that can be safely by only one worker. The prior art discloses a number of attempts to address this problem. U.S. Patent No. 2,718,282 (Davis), discloses spring tensioning apparatus having a splined cylindrical member with a longitudinal slot to permit mounting of the member over a spring shaft. The slot is then closed off using a secondary member that slides into longitudinal keyways in the cylindrical member on either side of the slot. The secondary member is also splined so as to create an effectively continuous splined perimeter around the cylindrical member when the secondary member has been positioned in the slot. The cylindrical member has means for connecting to a spring cone so that the spring cone will rotate when the cylindrical member is rotated. Also provided is a pair of pawl-equipped ratchet levers, each having a cylindrical inner surface and an opening to allow positioning over the shaft. The levers are placed over the shaft and slid over the splined cylindrical member, whereupon they may be operated in alternating fashion, with the pawls of the levers engaging the splines of the cylindrical member and causing it to rotate, thus rotating the spring cone and tightening the spring. Because the shaft openings in the levers are smaller than the diameter of the cylindrical member, the levers cannot come free of the cylindrical member without sliding them laterally off of the cylindrical member.

Although being a useful device, the Davis apparatus has several disadvantages. For example, it requires precise machining for splining of the cylindrical and secondary members, as well as for the keyways in the cylindrical member and the corresponding keys of the secondary member. Indeed, if the keyways are not machined to close tolerances, the secondary member will either fit too tightly (thus being difficult to install and remove) or it will be too loose (thus being prone to sliding out of the cylindrical member, making the apparatus inoperable. Even when these parts have been machined to provide an optimal fit, their mating surfaces can become damaged or covered with grime, paint, or other contaminants, in each case making insertion and/or removal of the secondary member difficult or impossible. Furthermore, the secondary member is of

necessity a loose component that could be accidentally lost, again making the apparatus unusable.

U.S. Patent No. 3,651,719 (Wessel) discloses another spring tensioning apparatus that operates on the ratchet principle. This apparatus features an hinged split collar assembly releasably mountable around a spring cone, with a rigid pin that goes into one of the spring cone sockets so that rotation of the collar will cause rotation of the spring cone. The split collar has rounded ratchet teeth around its perimeter, the teeth extending across the full width of the inner collar. The apparatus includes a pair of pawled ratchet handles, each with a hinged split collar section approximately half the width of the toothed inner collar. The Wessel apparatus is operated by opening the inner collar and mounting it to the spring cone, closing the inner collar and locking its hinged sections with an anchor pin, opening the ratchet handle collars of the ratchet handles and placing them over the inner collar, closing the ratchet handle collars and locking their hinged sections together with anchor pins, and, finally, operating the handles in alternating fashion to tighten the spring.

The Wessel apparatus also has disadvantages and drawbacks. Its installation requires the use of three anchor pins, and the loss of even one of these loose components may make the apparatus unusable. It also has several hinges that are prone to wear and breakage that could make efficient use of the apparatus difficult or impossible. Furthermore, installation of the Wessel apparatus on the spring shaft involves a number of steps before it is ready to operate, and these steps must also be performed in reverse in order to remove the apparatus from the shaft after the spring has been tensioned. This comparatively labour-intensive procedure increases the cost of spring tensioning.

Another ratchet-type spring tensioning device is found in U.S. Patent No. 5,605,079 (Way). This apparatus has a split housing, which is separable for installation onto the shaft and the spring cone, with a bore for receiving the shaft and a number of pins for engaging holes in the winding cone. A split sprocket is integrally mounted to the housing and an annular groove on each side of the sprocket receives a ratchet tool. The

ratchet tools are locked into the groove using bolts to prevent disengagement, and are operated in alternating fashion to rotate the sprocket, thus rotating the spring cone to adjust the tension in the spring. Disadvantages of this system include the number of loose components and the higher degree of assembly and disassembly required (i.e. assembly of the split housing and sprocket, attachment of the ratchet tools, and the corresponding disassembly once the adjustment is completed).

In view of the disadvantages of the prior art devices described above, there is a need for an improved apparatus for adjusting the tension of a helically wound torsion spring that has minimal or no small loose components prone to being misplaced, that has minimal hinged components prone to wear and disrepair, and that is simple to attach to and remove from a spring shaft, while being safely operable by a single worker. The present invention is directed to these needs.

## BRIEF SUMMARY OF THE INVENTION

In general terms, the invention is an apparatus for safely tensioning a torsion spring, without need for spring cone tightening rods that may pose an injury hazard in the event of an inadvertent release of spring tension during the tensioning operation. The apparatus features a central ratchet assembly with cogged ratchet wheels at each end, slotted to allow the assembly to be placed over the spring shaft adjacent to the spring cone. The ratchet assembly includes sub-apparatus connectable to the spring cone so that the spring cone (and therefore the spring) will rotate when the ratchet assembly is rotated. The slots in the ratchet wheels are closed by cogged bridging members to create a continuously cogged perimeter around the ratchet wheels. The apparatus includes a pair of pawl-equipped operating levers that may be positioned over the ratchet wheels so that the pawls can engage the ratchet wheel cogs. The levers may then be operated in alternating fashion to rotate the ratchet assembly, thus tensioning the spring.

Accordingly, in one aspect the present invention is an apparatus for tensioning a shaft-mounted helical spring having a first end fixed to a building support and a second end anchored to a spring cone lockably mounted on the shaft, said apparatus comprising:

(a) a ratchet wheel assembly comprising;

a.1 a trunnion having a substantially semi-cylindrical inner surface with a diameter slightly greater than the shaft diameter, and having a concentrically semi-cylindrical outer surface defining an open side; and

a.2 a pair of primary ratchet wheels, each having a centroidal opening plus a radial slot contiguous with the centroidal opening and extending therefrom to the wheel's perimeter and defining a gap in said perimeter, the diameter of the centroidal opening and the minimum width of the radial slot each being greater than the shaft diameter, said perimeter defining a continuous plurality of uniformly-spaced cogs between the edges of the perimeter gap, said primary ratchet wheels being spaced apart and coaxially mounted to the trunnion with their radial slots aligned with the open side of the trunnion such that the ratchet wheel assembly may be positioned substantially coaxially over the shaft;

(b) a pair of bridging members, each bridging member being associated with a corresponding one of the primary ratchet wheels; each bridging member defining an arcuate-edged section substantially matching the diameter of the primary ratchet wheel, said arcuate-edged section defining a plurality of cogs configured and spaced to match the cogs of the primary ratchet wheel over an arcuate length at least equal to the arcuate length of the perimeter gap of the corresponding primary ratchet wheel; and each bridging member being selectively operable between:

b.1 an engaged position, in which the arcuate-edged section bridges the perimeter gap of the primary ratchet wheel such that the cogs of the bridging member and the primary ratchet wheel combine to form a continuous and uniformly-spaced series of cogs; and

b.2 an open position, in which the arcuate-edged section is substantially clear of the perimeter gap and radial slot of the primary ratchet wheel so as to permit positioning of the ratchet wheel assembly coaxially over the shaft;

(c) locking means, for locking the bridging member in the open position;

(d) spring cone engagement means, for releasably engaging the spring cone such that the spring cone will rotate with the ratchet wheel assembly; and

(e) a pair of levers, each lever having a hub section rotatably mountable around the outer surface of the trunnion in association with one of the primary ratchet wheels, each lever having a pawl member with an inner end and an outer end, said inner end defining a cog-engaging surface and a non-engaging surface, each pawl member being mounted to its corresponding lever such that the pawl member may be retractably extended such that the cog-engaging surface may engage the cogs of one of the primary ratchet wheels and its corresponding bridging member.

In the preferred embodiment, the trunnion is a semi-cylindrical sleeve. In an alternative embodiment, the trunnion may be an elongate member having separate cylindrical outer surfaces for rotatably receiving the levers.

Also in the preferred embodiment, the primary ratchet wheels are mounted at opposite ends of the trunnion. In operation of the apparatus in this embodiment, the levers are mounted onto the trunnion inboard of the primary ratchet wheels. In an alternative embodiment, the primary ratchet wheels are mounted inboard of the ends of the trunnion, such that the levers are mounted onto the trunnion outboard of the primary ratchet wheels. In a variant of this alternative embodiment, the levers may be mounted either inboard or outboard of the primary ratchet wheels.

In the preferred embodiment, each bridging member is an auxiliary ratchet wheel having substantially the same configuration and features of the primary ratchet wheels. Each auxiliary ratchet wheel is rotatably and coaxially mounted to its corresponding

primary ratchet wheel, such that it is rotatable relative to the primary ratchet wheel between the open and engaged position. Unlike the primary ratchet wheels, the auxiliary ratchet wheels need not have cogs around their full perimeter, although that might be convenient or advantageous in some situations. What is important is for the auxiliary ratchet wheels to have sufficient cogs positioned so as to provide a substantially continuous series of cogs around the periphery of the combined primary/auxiliary ratchet wheel combination when in the engaged position. The cogs of the two wheels will necessarily lie in closely adjacent parallel planes, such that the cogs of both wheels are readily engageable by the pawl member of one of the levers.

Alternatively, each bridging member may be a cogged element smaller than its corresponding primary ratchet wheel, mountable thereto in either hinged or swivelling fashion so that it can either swing or swivel between the open and engaged positions. Where the bridging member is a cogged element hinged to the primary wheel, it may be adapted such that when in the engaged position its cogs will lie in the same plane as the primary wheel cogs. Alternatively, and in embodiments where the bridging member is a swivelling cogged element, its cogs will typically lie in a plane parallel to and closely adjacent to the plane of the primary wheel cogs, as in the case where the bridging members are auxiliary ratchet wheels.

In the preferred embodiment, each lever includes pawl biasing means, for biasing the lever's pawl member inwardly toward the primary ratchet wheel on which the lever may be mounted. The pawl biasing means may comprise a spring. Also in the preferred embodiment, each lever includes pawl orientation means, for selectively orienting the cog-engaging surface of the lever's pawl member to accommodate rotation of the ratchet wheel assembly in either direction. The pawl orientation means may be a handle associated with the outer end of the pawl member.

Each lever preferably includes pawl alignment means, to facilitate positioning of the lever on the trunnion with the lever's pawl member in optimal alignment with the cogs of the corresponding primary ratchet wheel and bridging member. The pawl

alignment means may comprise a guide member mounted to the hub section of the lever, with the guide member being rotatable against a rub plate mounted to the trunnion.

## BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described with reference to the accompanying figures, in which numerical references denote like parts, and in which:

**FIGURE 1A** is an exploded isometric view of the ratchet wheel assembly of the preferred embodiment of the invention, in which the bridging members are auxiliary ratchet wheels.

**FIGURE 1B** is an isometric view of a pair of ratchet levers for use in association with the ratchet wheel assembly of the invention.

**FIGURE 2** is a side view of the preferred embodiment, with the auxiliary ratchet wheels in the open position, ready for mounting of the apparatus on a spring shaft.

**FIGURE 3** is a side view of the preferred embodiment, mounted on a spring shaft with the auxiliary ratchet wheels in the open position.

**FIGURE 4** is a side view of the preferred embodiment, mounted on a spring shaft with the auxiliary ratchet wheels in the engaged position.

**FIGURE 5** is a partially-sectional elevation of the preferred embodiment, mounted on a spring shaft preparatory to engagement with the spring cone of a torsion spring.

**FIGURE 6** is an isometric view of the fully-assembled preferred embodiment, with the auxiliary ratchet wheels in the open position and ready for mounting on a spring shaft.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiment of the invention, generally represented by reference numeral **10**, is shown fully assembled in **FIG. 6**. To assist in understanding the construction of the preferred embodiment, reference may be made to **FIG. 1-A** and **FIG. 1-B**, which illustrate separate components and sub-assemblies forming part of the invention **10** when fully assembled, as will be described later herein. Referring to **FIG. 1-A,** a ratchet wheel assembly **20** is made up of two primary ratchet wheels **30** mounted to a trunnion **22**. The trunnion **22** has a semi-cylindrical inner surface **23** slightly larger in diameter than the torsion spring shaft **90** (see **FIG. 6**) on which it is intended to use the apparatus, such that the trunnion **22** can rotate substantially coaxially around the shaft **90**. The trunnion **22** has an open side **24** of a width greater than the diameter of the shaft **90** so as to allow the trunnion **22** to be removably positioned coaxially over the shaft **90**. The trunnion **22** also has a cylindrical outer surface **25**, for purposes that will soon be apparent. In the preferred embodiment, the trunnion **22** is a semi-cylindrical sleeve as shown in the Figures.

A pair of primary ratchet wheels **30** are coaxially mounted to the trunnion **22** in spaced relation. In the preferred embodiment shown in **FIG. 1-A**, the primary ratchet wheels **30** are mounted at opposite ends of the trunnion **22**; however, in alternative embodiments, either or both of the primary ratchet wheels **30** may be mounted a distance inboard from the ends of the trunnion **22**. Each primary ratchet wheel **30** has a centroidal opening **34A** and a radial slot **34B**, with the latter extending outward to the perimeter of the primary ratchet wheel **30** and creating a perimeter gap therein. The perimeter of the primary ratchet wheel **30** defines a plurality of uniformly-spaced ratchet teeth, or "cogs",

disposed continuously around the perimeter of the primary ratchet wheel **30** between the edges of the perimeter gap.

The diameter of the centroidal opening **34A** and the minimum width of the radial slot **34B** are both greater than the diameter of the shaft **90**, so as to allow the primary ratchet wheels **30** to be removably positioned coaxially over the shaft **90**. The centroidal opening **34A** and the radial slot **34B** are necessarily contiguous, but they are given separate reference numerals herein for ease of understanding. The radial slot **34B** is shown as being of essentially constant width, but this is not essential; what is essential is for the minimum slot width to be greater than the diameter of the shaft **90**.

Also provided, in association with each primary ratchet wheel **30**, is a bridging member with a cogged, arcuate-edged section, for closing off the perimeter gap in the primary ratchet wheel **30**. Each bridging member is operable between an "open" position, in which the radial slot **34B** of the associated primary ratchet wheel **30** is clear so as to permit mounting over the spring shaft **90**, and an "engaged" position in which at least a portion of the bridging member is positioned over the radial slot **34B** of the associated primary ratchet wheel **30** such that there will be a continuous series of cogs around the full perimeter of the primary ratchet wheel **30**, with the cogs of the bridging member providing the continuity of cogs across the perimeter gap in the primary ratchet wheel **30**. In addition, locking means are provided, for releasably securing each bridging member in the engaged position such that cogs of the bridging member cannot be displaced relative to the cogs of the associated primary ratchet wheel **30**.

As illustrated in **FIG. 1-A** and other Figures, the bridging members in the preferred embodiment will be auxiliary ratchet wheels **40** similar in construction to the primary ratchet wheels **30**, with corresponding centroidal opening **44A**, radial slot **44B**, and cogs **42**. Each auxiliary ratchet wheel **40** is rotatably mounted to its corresponding primary ratchet wheel **30** so as to be rotatably operable between the open and engaged positions. In the preferred embodiment, as particularly illustrated in **FIGS. 2**, **3**, and **4**, this rotatable operability is facilitated by providing a pair of arcuate slots **46** in each

auxiliary ratchet wheel **40**, and providing a stop post projecting through each arcuate slot **46** and anchored to the corresponding primary ratchet wheel **30**. As illustrated in **FIG. 1-A**, the stop post may be a machine bolt **54** (with or without washer **56**) which engages a mating threaded opening **36** in the corresponding primary ratchet wheel **30**. However, it will be readily apparent that the stop post could take any of several other forms. The arcuate slots **46** and stop posts are configured such that when an auxiliary ratchet wheel **40** is rotated in one direction until the stop posts hit the ends of their arcuate slots **46**, the auxiliary ratchet wheel **40** will be in the open position, and when the auxiliary ratchet wheel **40** is rotated in the other direction until the stop posts hit the other ends of their arcuate slots **46**, the auxiliary ratchet wheel **40** will be in the engaged position, with the spacing of the cogs **42** of the auxiliary ratchet wheel **40** conforming as desired with the spacing of the cogs **32** of the corresponding primary ratchet wheel **30**.

In the preferred embodiment, and as particularly illustrated in **FIGS. 2**, **3**, and **4**, the locking means is provided by way of a releasable pin **52** or other fastener that may be inserted through an opening **48B** in the auxiliary ratchet wheel **40** into a mating opening **38** in the corresponding primary ratchet wheel **30**. The pin **52** may be loose or, preferably, mounted to the auxiliary ratchet wheel **40** in spring-loaded fashion such that it will be biased to stay engaged in opening **38** when inserted therein, but may be conveniently withdrawn therefrom as desired. Although not essential to the invention, an additional opening **48A** may be provided in the auxiliary ratchet wheel **40** for holding the auxiliary ratchet wheel **40** in the open position, with said opening **48A** being located so as to align with opening **38** when the auxiliary ratchet wheel **40** is in the open position. It will be readily appreciated by those skilled in the art that various other locking means may be used without departing from the fundamental concept or scope of the present invention.

In alternative embodiments (not illustrated), the bridging member may be a comparatively small member with a cogged, arcuate-edged section just large enough to span the perimeter gap of the corresponding primary ratchet wheel **30**. Such a bridging member could be hinged adjacent one edge of the radial slot **34B** such that it would

swing between the closed position (in which it could lie either adjacent to the primary ratchet wheel **30** or in co-planar relation therewith) and the open position. In an another alternative embodiment, the bridging member could be swivellingly mounted to its primary ratchet wheel **30** so that it swivels between the open and closed positions about an axis parallel to the axis of the primary ratchet wheel **30**. In a yet further embodiment, the bridging member could take the form of a segment of an auxiliary ratchet wheel **40** of the illustrated preferred embodiment, with an arcuate slot **46** having a pair of stop posts extending therethrough, so as to allow the bridging member to rotate concentrically relative to its corresponding primary ratchet wheel **30**.

The invention **10** also includes spring cone engagement means **60**, which may take a variety of forms well known in the art of the invention. In the preferred embodiment illustrated in **FIGS. 1-A**, **5**, and **6**, the spring cone engagement means **60** has a central hub **62** and at least one outwardly-extending bracket **64** having mounted thereto a radially-oriented sleeve **66** which slidingly receives a cone-engaging pin **68** adapted to be insertable into a socket **96** of a spring cone **94**. The pin **68** may be spring-loaded to bias it radially inward, such that it will tend to stay engaged in the socket **96** when engaged therein. Alternatively, and as illustrated in **FIG. 5**, the pin **68** may have an operating wand **69** that extends through an L-shaped slot **67** in sleeve **66**, such that the pin **68** can slide within the sleeve **66** by moving the wand **69** within one leg **67A** of the L-shaped slot **67** for purposes of inserting the pin **68** into the socket **96** or retracting it therefrom, and such that the pin **68** can be releasably locked in position inside the socket **96** by moving the wand **69** into the other leg **67B** of the L-shaped slot **67**.

The spring cone engagement means **60** is mounted to other components of the invention **10** such that it will rotate with the ratchet wheel assembly **20**. In the preferred embodiment, and as particularly illustrated in **FIGS. 1-A**, **5**, and **6**, this is accomplished by rigidly connecting the spring cone engagement means **60** to one of the auxiliary ratchet wheels **40**, such as by welding. In other, unillustrated embodiments, however, such as where the bridging members are comparatively small and do not cover the entire

surface of their associated primary ratchet wheels **30**, the spring cone engagement means **60** may be mounted directly to one of the primary ratchet wheels **30**.

The invention **10** also comprises a pair of ratchet levers **70**, as illustrated in **FIG. 1-B**. Each lever **70** has a hub assembly **74** adapted to be rotatably mounted around the outer surface **25** of the trunnion **22**, and for that purpose will preferably have a bushing element **72** with an inner diameter slightly greater than the diameter of the outer surface **25** of the trunnion **22**. The configuration of the hub assemblies **74** as shown in the Figures is merely representative; various other hub configurations could be used without departing from the scope of the invention.

Each lever **70** also has a pawl assembly **80** comprising a pawl member **82** with an inner end **82A** and an outer end **82B**, with the inner end **82A** defining a cog-engaging surface **83A** and a non-engaging surface **83B**. The pawl member **82** is mounted to the lever **70** in any suitable fashion such that its inner end **82A** can be retractably extended inward toward the hub **74**. In the particular embodiment shown in **FIG. 1-B** and **FIGS. 2** through **6**, the outer end **82B** of the pawl member **82** passes slidably through a bracket **86** mounted to the lever **70**, and the inner end **82A** of the pawl member **82** passes slidably through an opening in the hub **74**. In the preferred embodiment, the pawl member **82** is provided with a spring **84** (with spring retainer means **84A**) or other biasing means, for biasing the pawl member **82** inward toward the hub **74**.

Preferably, the pawl member **82** is also provided with pawl-orientation means, for orienting the cog-engaging surface **83A** as desired, depending on the direction in which the lever **70** is to be operated. As illustrated in the Figures, the pawl-orientation means can be provided by way of a handle **88** associated with the outer end **82B** of the pawl member **82**. However, this is merely one example, and those skilled in the art of the invention will understand that various other pawl-orientation means could be used without departing from the concept or scope of the invention.

Assembly of the preferred embodiment of the invention **10** may now be readily understood having reference to **FIGS. 5** and **6** in particular. The levers **70** are positioned between the primary ratchet wheels **30** so as to be rotatable around the outer surface **25** of the trunnion **22**, with the pawl member **82** of each lever **70** aligned so as to be able to engage the cogs **32** of one of the primary ratchet wheels **30** as well as the cogs **42** of the associated auxiliary ratchet wheel **40** (or other form of bridging member) as the case may be. In the illustrated embodiment, the required alignment of the pawl members **82** is accomplished by providing rub plates **26** on the trunnion **22** and providing a guide member (typically a flat plate) **76** in association with each hub **74**, with these components being configured and positioned such that the pawl members **82** will be properly aligned when the levers **70** are rotated with their guide members **76** closely adjacent their corresponding rub plates **26**. Persons skilled in the art of the invention will readily appreciate that other suitable alignment means may be devised without departing from the scope of the invention.

In the illustrated embodiment, the levers **70** cannot be readily removed from the ratchet wheel assembly **20** because of the geometry of the assembly, and in particular the fact that the hubs **74** in the illustrated embodiment closely enshroud their corresponding primary ratchet wheels **30**. In this arrangement, the invention **10** has no loose components that might be inadvertently misplaced. More significantly, perhaps, this arrangement prevents the levers **70** from flying loosely away from the ratchet wheel assembly in the event of an unexpected unwinding of a torsion spring being tensioned with the apparatus. However, there may be circumstances in which it will be desirable for the levers **70** to be removable, which can be easily accomplished by modifying the configuration of the hubs **74** (e.g., by making them essentially semi-circular or smaller) so that they can be mounted directly over their corresponding primary ratchet wheels **30**.

The operation of the present invention may now be easily understood having particular reference to **FIGS. 5** and **6**. With the bridging members in the open position, the apparatus of the invention **10** is coaxially mounted over a torsion spring shaft **90** adjacent a spring cone **94** on the side opposite the torsion spring **92** anchored thereto.

The apparatus is then moved laterally as required such that the spring cone engagement means **60** can engage the spring cone **94**. The bridging members are moved to their engaged positions and locked; as preferred or convenient, this step may be taken either before or after engagement of the spring cone **94**. With the spring cone **94** free to rotate about the shaft **90**, with the pawl members **82** oriented as desired, and with the pawl-engaging surfaces **83A** aligned to engage cogs **32** and/or **42** as the case may be, the two levers **70** may be operated with one lever **70** being used to restrain the spring **92** from unwinding while the other lever **70** is operated in typical ratchet fashion so as to rotate the spring cone engaging means **60**, in turn tensioning (or relaxing the tension in) the spring **92**, depending on the direction of rotation. When the spring **92** has reached the desired level of tension, the spring cone **94** may be anchored to the shaft **90** (typically by means of set screws **98** as shown in **FIG. 5**), whereupon the spring cone engaging means **60** may be disengaged, the bridging members may be moved to the open position, and the apparatus may be removed from the shaft **90**.

It will be readily appreciated by those skilled in the art that various modifications of the present invention may be devised without departing from the essential concept of the invention, and all such modifications are intended to be included in the scope of the claims appended hereto.

In this patent document, the word "comprising" is used in its non-limiting sense to mean that items following that word are included, but items not specifically mentioned are not excluded. A reference to an element by the indefinite article "a" does not exclude the possibility that more than one of the element is present, unless the context clearly requires that there be one and only one such element.